

What is claimed is:

1. A process for preparing 3-pentenenitrile, characterized by the following process steps:

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(a) reacting 1,3-butadiene with hydrogen cyanide over at least one catalyst to obtain a stream 1 which comprises 3-pentenenitrile, 2-methyl-3-butenenitrile, the at least one catalyst and 1,3-butadiene,

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(b) distilling stream 1 in a column to obtain a high-1,3-butadiene stream 2 as the top product and a low-1,3-butadiene stream 3 as the bottom product which comprises 3-pentenenitrile, the at least one catalyst and 2-methyl-3-butenenitrile,

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(c) distilling stream 3 in a column to obtain a stream 4 as the top product which comprises 1,3-butadiene, a stream 5 which comprises 3-pentenenitrile and 2-methyl-3-butenenitrile at a side draw of the column, and a stream 6 as the bottom product which comprises the at least one catalyst,

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(d) distilling stream 5 to obtain a stream 7 as the top product which comprises 2-methyl-3-butenenitrile, and a stream 8 as the bottom product which comprises 3-pentenenitrile.

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2. The process according to claim 1, wherein the reaction in process step (a) is carried out over a homogeneously dissolved nickel(0) catalyst which is stabilized with phosphorus ligands.

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3. The process according to claim 2, wherein the phosphorus ligands are selected from the group consisting of phosphines, phosphites, phosphinites and phosphonites.

4. The process according to any of claims 1 to 4, wherein the high-1,3-butadiene stream 2 from process step (b) is recycled at least partly into process step (a).

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5. The process according to any of claims 1 to 4, wherein, in process step (c), stream 6 is obtained via the bottom with a concentration of 2-methyl-3-butenenitrile which is lowered in comparison to stream 5, the lowering being based on the ratio of the concentrations of 2-methyl-3-butenenitrile to trans-3-pentenenitrile.

6. The process according to any of claims 1 to 5, wherein stream 6 from process step (c) is recycled at least partly into process step (a).
7. The process according to any of claims 1 to 6, wherein stream 4 from process step (c) is recycled at least partly into process step (a) and/or (b).
8. The process according to any of claims 1 to 7, wherein stream 5 is withdrawn in vaporous form at the side draw in process step (c).
- 10 9. The process according to any of claims 1 to 8, wherein stream 1 is transferred directly to process step (c) with exclusion of process step (b).
10. The process according to any of claims 1 to 9, wherein stream 7 from process step (d) is recycled at least partly into process step (a) and/or process step (b).
- 15 11. The process according to any of claims 1 to 10, wherein, in process step (c), there are from 1 to 50 distillative separation stages between the position of the side draw and the column bottom.
- 20 12. The process according to any of claims 1 to 11, wherein the proportion of 2-methyl-3-butenenitrile in the catalyst stream 6 obtained in process step (c) is from 0 to 5% by weight.
- 25 13. The process according to any of claims 1 to 12, wherein, in process steps (b) and (c), the bottom temperatures do not exceed 140°C.
14. The process according to any of claims 1 to 13, wherein the sum of the average residence times in the distillation apparatus in process steps (b) and (c) together is not more than 10 hours.